



## Effects of Future Land Use Assumptions On Environmental Restoration Decision Making

- BACKGROUND:** Although the preamble to the National Contingency Plan (NCP) appears to have a bias for assuming residential land use as the future use for remediated sites, it also states that such an assumption may not be justifiable if the "probability that the site will support residential use in the future is small." Similarly, the proposed RCRA Corrective Action rule states that current and reasonably expected future land use and corresponding exposure scenarios should be considered in the selection and timing of corrective actions. The Environmental Protection Agency (EPA) directive on land use in RCRA and CERCLA remedy selection concludes that incorporating future land use assumptions into baseline risk assessments and feasibility studies allows for developing practicable and cost effective remedial alternatives (ref. 1). Developing reasonably anticipated future uses is based upon information on the risks posed by the site, the most appropriate uses of the land, and the feasibility of complete cleanup. This Information Brief illustrates how consideration of reasonably anticipated future land uses impacts remediation decision making.
- STATUTES:** RCRA Corrective Action Authorities, i.e., Sections 3004(u), 3004(v), 3005(c)(3), 3008(h), 3013, 6001, and 7003; CERCLA Section 120 (Federal Facilities), and Section 121 (Cleanup Standards)
- REGULATIONS:** 40 CFR 300.430, "Remedial Investigation/Feasibility Study and Selection of Remedy." 40 CFR 264.101 "Corrective Action For Solid Waste Management Units"
- REFERENCES:**
1. "Land Use in the CERCLA Remedy Selection Process," EPA/OSWER Directive No. 9355.7-04 (5/25/95).
  2. "Characterization of Uncertainties in Risk Assessment with Special Reference to Probabilistic Uncertainty Analysis," Information Brief DOE/EH-413-068/0296 (2/96).
  3. "Corrective Action for Releases From Solid Waste Management Units at Hazardous Waste Facilities," 61 FR 19432 (5/1/96).
  4. "Remedial Investigation/Feasibility Study (RI/FS) Process, Elements, and Techniques Guidance Module 7 Streamlined Approach for Environmental Restoration (SAFER)," DOE, EH-94007658 (12/93).
  5. "Guidance on Implementation of the Superfund Accelerated Cleanup Model (SACM) under CERCLA and the NCP," EPA/OSWER Directive No. 9203.1-03 (7/92).
  6. "National Oil and Hazardous Substances Pollution Contingency Plan: Final Rule," 55 FR 8666 (3/8/90).
  7. "Notice of Availability and Opportunity to Comment on Proposed Guidelines for Ecological Risk Assessment," 61 FR 47551 (9/9/96).
  8. "Risk Assessment Guidance for Superfund: Volume-Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals) Interim," EPA 9285.7-01B (12/91).
  9. "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," EPA 540/G-89/004 (10/89).
  10. "Using the Data Quality Objectives Process During the Design and Conduct of Ecological Risk Assessments," Information Brief DOE/EH-0544 (2/97).

### How Do Land Use Assumptions Impact Remedial Decision Making Under CERCLA and RCRA?

Remediation under CERCLA and RCRA is designed to mitigate potential risks to human health and the environment. Risk is a function of toxicity and exposure; one key determinant of exposure is the reasonable future use of the land (ref. 2). Land use affects behavior and behavior determines exposure.

Future land uses can, in some cases, also increase the importance of ecological risk in environmental restoration.

Reasonably anticipated future land uses and the risk inherent in them can be incorporated early and iteratively in remediation decision making in order to streamline the process and eliminate other land use analyses that are deemed inappropriate.

## **What Elements are Involved in Developing Reasonably Anticipated Future Land Uses?**

Early, on-going, cooperative discussion with local and tribal governments and affected communities (ref. 1) is a key element in developing future land uses. The other major element is reliable information on the nature and extent of contamination on, and existing and planned uses of specific parcels of contiguous land.

## **How Are Land Use and the Development of Investigation/Remediation Work Plans Related?**

In general, decreased land use restrictions could result in increased exposure and risks to human receptors. Thus, as the tolerance for uncertainty in work plans diminishes due to the risks associated with land uses, investigation work plans become more complex, costly, and lengthy as restrictions associated with future land use decrease.

One objective of the investigation/remediation work plan is quantifying risks based on both current and reasonably foreseeable future land uses. Since many of the sites undergoing environmental restoration remain under Departmental control, scoping investigation work plans to quantify risks and develop remedial action objectives for current land use is relatively straightforward.

Current land use on most DOE sites is restricted and nonresidential. However, future land use at DOE sites may be uncertain, or a number of land use scenarios can be reasonably anticipated. All reasonably anticipated future land uses must be considered in developing remedial action objectives (ref. 1). Thus, investigation/remediation work plans must be either expanded or contracted to accommodate the range of reasonably anticipated future land uses possible at a given site.

For example, an assumption of unrestricted land use will result in work plans with a bias towards treatment or the complete removal of contaminant threats, for remedy under CERCLA and RCRA. The EPA expects that CERCLA remedies will rely on treatment to remove principal threats (40 CFR 300.430(a)(1)(iii)) and RCRA remedies will “address the principal threats posed by a site whenever practical and cost effective.” (ref. 3, p. 19448). Thus, work plans for the investigation and remediation of DOE sites to be released for unrestricted land use need to address the sampling and analysis requirements necessary for the treatment and/or removal of principal threats to acceptable risk levels.

## **How Will Land Use Affect Development of Data Sampling and Analysis Plans?**

Both DOE and EPA recommend strategies to collect the data needed to support remedial decision making (ref. 4, ref. 5). Such strategies are needed because the time, effort, and costs associated with data collection can vary significantly depending upon the goals for data collection.

Current and future land use assumptions can be used as a basis for developing Data Quality Objectives, decision statements and rules, and focusing sampling and analysis plans. For example, if land use will be unrestricted (and thus human contact with the land will be unrestricted), data generated in the characterization phase will need to be of high quality so that human health risks can be quantified and managed with a high degree of certainty.

The analytical options to support data collection activity are designated by EPA as Analytical Levels I through V (ref. 9). These Levels are distinguished by their analytical technologies, degree of documentation and sophistication, portability, and QA/QC protocols. The exacting QA/QC controls and low method detection limits associated with Analytical Level IV Methods are likely to be required when highly documented data, as would be needed for unrestricted use analysis, must be obtained. Analytical Level IV Methods involve Contract Laboratory Program (CLP) analytical procedures with rigorous quality assurance/quality control protocols as well as documentation and validation procedures. The collection, validation, and maintenance of these protocols and procedures can be costly, resource intensive and time consuming.

In contrast, land use with associated usage restrictions to limit human exposure could allow site investigators to use analytical methods that can quantify constituents of concern at higher detection limits than would be the case if an Analytical Level IV method were used. A sampling and analysis plan using Analytical Level III Methods may be appropriate in such situations because, although it may or may not involve CLP analysis, it does not require CLP validation or documentation procedures. The absence of those requirements can result in cost savings over Analytical Level IV Methods.

Alternatively, Analytical Level II Methods may also be appropriate in restricted future use scenarios. The field analysis, mobile laboratories and direct reading techniques such as X Ray Fluorescence used in Analytical Level II are appropriate for site

characterization, engineering design, and evaluation of alternatives and may generally be less costly and resource intensive than Analytical Level III Methods.

Use of Analytical Level II Methods can also shape sampling and analysis plans through use of rapid sample collection and on-site analysis allowing for on-site decision making. This can lead to the prompt identification of actual or potential risks to human health and ecological resources, and more rapid assessment of the need for interim measures (ref. 3).

### **What Impact Will Land Use Assumptions Have Upon Risk Assessments?**

Risk assessments are based on toxicity and exposure. Exposure is affected by a number of factors including the types of contaminants (radiological versus hazardous), the initial concentrations of contaminants at the release point, the release mechanism, the environmental fate of the contaminants, and the resulting concentrations of the contaminants at the exposure point. One additional factor which will have a significant impact on exposure is land use.

Exposure results from the co-occurrence of receptors with contaminants at the site and the presence of a complete exposure pathway between the contaminants and the receptor. The nature of exposure pathways will be determined by future land uses. Risk assessments for unrestricted land use will assume no control of the exposure pathways whereas those for restricted land use will feature control of one or more exposure pathways.

For example, for the typical DOE site, current land use exposure assumptions in a risk assessment involve, among other factors, the exposure of site workers to contaminated environmental media at an exposure point concentration for a specified time. The exposure pathway is controlled because workers can only come into contact with the contaminants periodically during the work week.

However, the exposure pathway would be uncontrolled if land use assumptions involve unrestricted residential land use. There is then potential for human receptors to come into contact with contaminants at the exposure point concentrations more frequently and for longer time periods than would be the case for a restricted land use.

Exhibit 1 is extracted from an EPA guidance document on the development of preliminary remediation goals (ref. 8).

Exhibit 1: Default Values for Soil Pathway

	Exposure Frequency (days/yr)	Exposure Duration (yr)
Commercial/ Industrial Land Use	250	25
Residential	350	30

It highlights the effect of land use assumptions on the performance of a risk assessment by demonstrating the variation in exposure frequency and exposure duration between restricted (commercial/industrial) and unrestricted (residential) land use assumptions.

### **How Are Reasonable Land Use Assumptions Factored Into the Development of Remedial Alternatives?**

Remedial alternatives developed for analysis under CERCLA and RCRA are based upon remedial action objectives associated with land uses for the site. Site investigators should rely on future land use assumptions when conceiving the remedial action objectives that become the basis for the remedial alternatives to be evaluated in the feasibility study process (ref. 1). Thus, only those remedial alternatives with remedial action objectives associated with reasonably anticipated future land uses should be subject to the more exhaustive analysis using the nine evaluation criteria in the feasibility study.

Nonresidential land use is the likely default assumption for active RCRA facilities. Thus, it would be unnecessary to use a remedial action objective protective of residents as the basis of a corrective measure at an active RCRA facility. However, all reasonably foreseeable future land use assumptions should be assessed when developing remedial action objectives for any given facility under RCRA (ref. 3) just as they should under CERCLA (ref. 6).

EPA's expectations for remedies include a combination of treatment, engineering controls, and institutional controls as needed. However, institutional controls may be key elements of the remedial alternatives associated with some future land uses because a function of institutional controls is preservation of land use assumptions. As such, the practicability and cost of anticipated institutional controls built into a remedial alternative for future land uses must be as thoroughly investigated as the proposed treatment technology.

## **What is the Effect of Restricted Land Use on the Importance of Ecological Risk in the Environmental Restoration Process?**

Both RCRA and CERCLA fully integrate ecological risk assessment requirements into the characterization and response phases in an attempt to quantify and, if necessary, mitigate risk to ecological resources. Future land uses and remedial alternatives associated with them can have significant impacts on risks to ecological resources. When non-residential land use assumptions are relied upon, some “industrial” action levels or media cleanup standards may not be protective for ecological receptors. As a result, at some sites, risks to ecological resources could result in cleanup levels which could be lower than would be the case for human receptors.

Furthermore, nonresidential land use assumptions could be based upon the fact that a facility will remain active in the long-term and continue to maintain the exposure controls that minimize risk to human receptors. In the case of such active facilities, continued performance of the ecological risk assessment could be required after the remedy is implemented to substantiate that the remedy had the desired effect (refs. 7, 10).

*Questions of policy or questions requiring policy decisions will not be dealt with in EH-413 Information Briefs unless that policy has already been established through appropriate documentation. Please refer any questions concerning the material covered in this Information Brief to John Bascietto, RCRA/CERCLA Division, EH-413, (202) 586-7917.*

